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PLEASE NOTE

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Table of Contents

I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Sputnik III

The 27 July issue of Izvestiya has a full page devoted to Sputnik III. A resume of the articles follows.

Sputnik III completed 1,000 revolutions of the Earth on 27 July at 2021 hours. During this period, its orbital time has decreased by 0.85 minute and is at present 105.1 minutes. The apogee has decreased from 1,880 kilometers to 1,800 kilometers. In comparison, the parameters of Sputnik I and II underwent a more substantial change for this same period of time. Sputnik I orbital time lessened by 3.5 minutes, and Sputnik II, by 3.9 minutes. Their apogees decreased correspondingly by 330 kilometers and 370 kilometers. The quicker changes in the orbital parameters of Sputnik I and II are explained by their smaller cross-sectional loading.

More than 38,000 radio measurements, 1,200 optical observations of Sputnik III, and 4,000 observations of its carrier rocket have been obtained and processed by the coordination and computing center so far. The precise orbital parameters of a satellite in its initial movement and the nature of the changes in them with time can be determined according to these data. The measurements of the trajectory for the motion of a satellite which are obtained make it possible to accomplish a precise geographic tie-in of the results of scientific observations conducted by Sputnik III.

Both the solar and chemical batteries which power the "Mayak" radiotransmitter are reported still functioning satisfactorily.

Sputnik III is observed as a star of the fourth or fifth magnitude and its carrier rocket as a star of minus third to fourth magnitude. Observations of the carrier rocket have revealed a sharp periodic reduction in its brightness through every 7 to 10 seconds. This is caused by the tumbling of the rocket.

V. Sokolov, engineer, in a lengthy article discusses the methods of investigating the atmosphere by means of rockets and artificial earth satellites. Most of the article is a review of previously presented information on Sputnik III instrumentation.

V. Tsesevich, Doctor of Physicomathematical Sciences and director of the Odessa Astronomical Observatory, in an accompanying article, discusses two of the most important problems which now confront Soviet scientists.

The first is the study of the laws according to which a body, moving freely in terrestrial space under the action of the Earth's gravity, rotates around its own axis. This problem, says Tsesevich, is of great practical value for the development of the science of interplanetary travel and of astronautics.

It was found that all of the Soviet satellites and their carrier rockets undergo complex rotational movements around their cross sectional axes, as though somersaulting. This motion, declares Tsesevich, arises mainly as a result of the irregular combustion of the rocket's fuel in the last moment of launching the satellite at its entrance into orbit.

Sputnik II was carefully studied from this point of view on the basis of observations of its brightness, conducted in a number of locations in the Soviet Union. An especially great number of observations were made by astronomers Kovbasyuk and Kularin in Gor'kiy, Vashkevich in Leningrad, and groups of astronomers in Vil'nyus and Odessa. As a result, the rotation of Sputnik II was successfully tracked for more than 80,000 of its turns to determine the period of its rotation. It was found to be close to 208 seconds. At present, the full mathematical processing of all of the observations has been done to determine the direction of the axis of rotation.

Sputnik III and its carrier rocket presented still greater interest from this point of view. They rotated around their axes much more quickly. Hundreds of observations on the carrier rocket's flashes have been obtained. It has been established that over 2 months, the period of rotation has changed little.

In regard to the satellite itself, it has been observed to undergo great variations of brightness also, sometimes being seen as a star of the first magnitude and at other times requiring the use of a telescope or binoculars. In observations conducted on 14 June by Tsesevich, the satellite was observed to attain the brightness of the bright stars of alpha Cygni, after which it faded. Approximately through 20 seconds, the brightness again increased and attained the brightness of a star of the second magnitude. He determined that Sputnik III rotated around its axis in a period of about 40 seconds.

Tsesevich next discusses the problem of returning a satellite to Earth. It is possible, he says, that first attempts may be to return not the entire satellite, but only its instruments. To do this, the satellite would have to be equipped with a second container in which the instruments would be housed. This container would have to be a small rocket containing a reserve of fuel. Up to now, states Tsesevich, it has not been necessary to return a satellite to Earth.

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At the proper moment, this rocket container must be separated from the satellite and its motor automatically started so it may begin its independent flight in the opposite direction in relation to the orbital velocity of the satellite. Then, the cosmic speed will be canceled. The rocket container will enter its own decreasing spiral orbit near the Earth, enter the dense layer of the atmosphere with decreased speed, and then lower by parachute.

But, continues Tsesevich, to cancel the velocity, it is necessary to direct the rocket container exactly counter to the motion of the satellite, and its flight must be thoroughly oriented so that it does not inherit the satellites tumbling action.

"To accomplish this, it is first necessary to study the laws according to which satellites rotate in space. This is the aim of the photometric observations of the brightness of rockets and artificial satellites."

A final article devoted to the radio transmitter "Mayak" adds nothing new to previously reported information on either the transmitter or radio observations of Sputnik III. (Moscow, Izvestiya, 27 Jul 58)

Chinese Study Orbital Motion of Artificial Earth Satellite.

Y. C. Chang and Chang Chia-hsiang, Purple Mountain Observatory, Nanking, write about "An Investigation of the Orbital Motion of an Artificial Satellite."

The authors suppose that the artificial satellite has been launched toward the zenith of a location at 30° N latitude. Its orbital motion will begin at a height of 300 kilometers. This point is to be the perigee. An apogee of 1,200 kilometers is required and the inclination of the orbit to the equator should be 40°. The authors say they have found that the velocity at perigee should be 7.962 kilometers per second in the direction of an azimuth of $62^\circ 13'$ east of south, with an eccentricity of $e = 0.0631$, and an orbital period of 1.665 hours. In the case of a satellite moving in a circular orbit at a height of 300 kilometers, the orbital velocity would need to be only 7.721 kilometers per second and an orbital period of 1.510 hours.

The Earth is considered as an oblate spheroid. A potential function is presented and components of force are obtained. The rate of regression of the node along the equator is calculated.

An extrapolation formula for evaluating the effect of atmospheric density on the motion on an artificial earth satellite based on Rocket Panel atmospheric data is obtained. An entirely empirical but simpler formula for log ρ is derived.

A formula is presented for the force experienced by a body moving in a resisting medium.

Variations (decreases) in a (semimajor axis) and e are calculated by formulas derived by the authors. Beginning form an orbit of a = 7,130 kilometers, e = 0.0631, a satellite having a mass of 10,000 grams, and a cross-sectional area of 2,827 square centimeters, the decreases in the semimajor axis are computed for intervals of 40 kilometers. The results of the computations are presented in tabular form.

The derivation of the potential function of an oblate spheroid on an exterior particle from elementary principles is presented. (Acta Astronomica Sinica, Vol 5, No 2, Dec 57, pp 196-221)

II. METEOROLOGY

Controlling Weather and Climate

At the request of readers and in conjunction with the current IGY, the editors of the Soviet journal, Voprosy Filosofii (Problems in Philosophy), requested Ye. K. Fedorov, Corresponding Member of the Academy of Sciences USSR, to write on problems in geophysics which would be of interest to philosophers and, in particular, sociologists. In his article, "Influence of Man on Meteorological Processes," Fedorov deals mainly with problems concerning active influence of weather and climate. General problems concerning the influence of man over matter are treated by Yu. Z. Zhdanov in his book, Vozdeystviye Cheloveka na Meteorologichekiye Protsessy (Influence of Man on Natural Processes).

Following are the major points of interest as given by Fedorov, which, although being of general nature at times, give some idea of the Soviet approach to the problem:

At present, the absence of a quantitative theory limits weather forecasting mainly to predictions on the basis of qualitative relationships. The development of a quantitative theory of atmospheric processes as a means for calculation of their future development is without doubt the most essential and extremely important problem in modern physics. Problems of reporting and analysis are far from being completed and the problem of forecasting geophysical phenomena is only beginning to be developed in quantitative form. Along with these, a third problem appeared, the study of the possibilities and search for possible means of active influence on the processes.

The displacement of air masses, appearance of cyclonic formations on frontal boundaries, and development of clouds and precipitation are tied in with the transformation of tremendous amounts of energy from one form to another. For example, in the formation and development of several cumulus clouds of average size, about 10^{14} calories are expended in 3 to 4 hours. This is the amount of energy that could be produced in the same period of time by 20 hydroelectric stations equal in power to that of Kuybyshev.

To produce a wind of 20 meters per second velocity over a front of 200 kilometers for a 3 to 4 hour period would require about 10^{15} calories of energy.

To change the course of a large air mass, i.e., to change the character of weather for several days over a territorial expanse of about 1,000 kilometers would require the expenditure of 10^{16} to 10^{18} calories of energy.

Such great energy of ordinary meteorological processes is not surprising if one is to consider that its primary source, solar energy, supplies about 2.10^{12} calories to each square kilometer of the Earth's surface each day and an approximately equal amount is absorbed in the atmosphere.

The great energy in atmospheric processes serves as the basic obstacle in overcoming them. This situation prompted the majority of geophysicists 20 to 25 years ago to consider that although man's influence over meteorological processes is possible in principle, actual accomplishment would be impractical. Such an opinion is basically true even today, if one considers active influence as directly overcoming any one meteorological phenomenon. An example of such direct control of a natural process would be the attempt by US aviation in World War II to disperse fog over an airfield by heating the air. Although the method was successful in clearing the fog to an altitude of several tens of meters, its cost as compared to its effectiveness made practical application impossible.

Obviously, influence of meteorological processes should be accomplished from another direction, according to the principle of control. This means bringing large quantities of energy and matter to bear in the desired direction. The controlling effect itself should be accompanied with expenditures of energy and matter in quantities that are much less. There are organs and channels of control in the automatization of machines and in living organisms themselves, and such channels of control exist in atmospheric processes. To find then, it is necessary to seek out the links between one phenomenon and the other in the complex atmospheric processes.

Atmospheric phenomena, more than any other phenomena, are saturated with an interaction -- a struggle of contradictory beginnings. On one hand, an air mass preserves its physical characteristics for a considerable period of time (its temperature, moisture content, and foreign body content) while, on the other hand, by this inertia or conservatism, it resists the ability of air masses to change and, under certain conditions, to sharply change its physical properties. Thus, for example, in air masses containing water vapor in a concentration near saturation, fog and clouds form after little cooling, basically changing the optical properties of the air and creating different conditions for heat transfer in the atmosphere and on the soil. Also, the atmosphere is very sensitive to the presence of certain foreign substances in quantities insignificant in comparison with the air in which they are mixed.

For clouds to form, while having a sufficient concentration of water vapor, there must be nuclei for condensation. On their physical properties depends the moisture content sufficient for initial condensation, drop growth rate, and all kinetics in the further development of the cloud. The total mass of condensation nuclei necessary for formation of a cloud system with a volume of tens of thousands of cubic kilometers is about 10 kilograms.

The development of many atmospheric processes frequently leads to unstable (critical) conditions particularly sensitive to one or another form of interference. Such, for example, is the condition of a supercooled water cloud. Addition of proper nuclei to a supercooled cloud in a negligible quantity (about $1/10^7$ to $1/10^8$) compared to the mass of the cloud leads to transformation of the cloud into a crystalline state, the formation of precipitation and other results.

The contradictory character in the development of meteorological processes, tied in with, in many cases, its instability and capacity to alter its development under the effect of small disturbances, serves as an opportune moment in the evaluation of the possibility and the search for methods of control.

Two possible methods of control can be examined. The first method involves interference in the natural development of processes at a certain suitable predetermined moment during their unstable state. The second involves creation of stable changes in components of atmospheric circulation and corresponding changes in climate by means, for example, of transformation of the underlying surface, building of special permanent structures, changing of sea currents, or other long-term methods.

An example of utilization of the first method is the rapidly developing technology of influencing clouds. Attempts in influencing clouds to disperse or force precipitation have a long history. This problem was first placed on a scientific basis in the USSR in the late 1920s.

In 1931, Soviet geophysicists had developed a broad plan for investigations of cloud physics designed for seeking methods of actively influencing precipitation, and appropriate operations were begun (see the newspaper 'Ekonomicheskaya zhizn', No 181, 1931). The aim of these investigations was to develop one of the possible methods for combating drought. "At the same time, none of the serious scientists abroad were involved in problems of active influence, leaving individual attempts at the mercy of a few lone enthusiasts and a large number of quacks."

In 1931, Professor Marvin, director of the meteorological service in the US, published the claim of the impossibility of active interference in the formation of clouds (Meteorologicheskiy vestnik, No 5-8, 1931, p 80).

From 1934 to 1937, in the Leningrad Institute of Experimental Meteorology and other Soviet scientific research institutes, the first successful experiments on active influencing of clouds were performed under natural conditions by V. N. Obolenskiy and V. A. Fedoseyev (Basilevich and others, Trudy GUGMS [Main Administration of the Hydrometeorological Service of the USSR], Series 1, No 1, 1941; V. A. Solov'yev, Meteorologiya i gidrologiya, No 3, 1941; V. Ya. Nikandrov, Trudy Glavnoy geofizicheskoy observatorii, No 09, 1950)

In the same period, V. N. Obolenskiy and M. A. Aganin and other Soviet scientists fully investigated certain of the most important phenomena constituting natural processes in the formation of precipitates. The Soviet researchers did by no means consider the first results of the in-nature experiments to be a successful solution of the problem, as precipitation in sufficient quantity was not obtained. The onset of war considerably curtailed the volume of operations. After the war, they were resumed, and at present, they are being conducted in various scientific institutes.

Basic results achieved in the USSR (the works of V. Ya. Nikandrov, I. I. Gayvoronskiy, A. P. Chuvayev, and others) and abroad up to now point out the principal and practical possibility of exerting active influence on a cloud as a result of which its structure is basically changed. Change in the structure of a supercooled cloud can be achieved by several means. The most widely used is the introduction of grains of solid carbon dioxide into the cloud. Supercooling occurs on the surfaces of the dry ice particles, which have a temperature of about -70 degrees Centigrade, and a large quantity of very small ice crystals is formed.

The joint existence of ice crystals and supercooled drops of water results in growth of the crystals and vaporization of drops in the cloud due to the difference in pressure of the saturated water vapor above the ice and water. Thus, the cloud disperses and precipitations form.

Experience has shown that this process occurs best at a temperature of about -10 degrees centigrade. It is interesting to note that the nuclei of crystallization spread out from it source (seeding zone of dry ice in the cloud) to a distance from one to 2 kilometers with considerable speed, about 3 meters per second.

Several hundred grams of dry ice ejected from an airplane are sufficient for the transformation into a crystalline state and dispersal of a one-cubic-kilometer cloud (at a temperature of -5 to -20 degrees centigrade).

Nuclei for crystallization of a supercooled water cloud can not only be ice crystals, but also, as experiments have shown, small particles of other substances such as smoke particles of the iodine compounds AgI and PbI.

Crystallization of a supercooled drop can be stimulated also by acoustical vibrations. However, this and certain other methods have still not progressed further than the laboratory stage of experiment, while the influence of dry ice and iodine compounds are being widely investigated under natural conditions and are beginning to be applied in practice.

Despite the simplicity of the basic action of CO_2 and AgI in a large number of experiments, the mechanism of the described phenomena, up to now, is not understood in man respects. It has not been identified with complete reliability and the quantitative relationships which occur in the reaction (for example, the necessary reacting substances and their dosage, etc.) have not been determined.

Although supercooled water clouds exist in the temperature range from 0 degrees centigrade to -39 degrees centigrade and are therefore quite a common phenomenon, the possibility of transformation of clouds and fog which develop during positive temperatures is naturally of great value. The direct objective in this case undoubtedly should be the stimulation or retardation of drop growth which would insure dispersal of the cloud, or forcing or retarding of precipitation.

Certain successes have been attained in recent years in this direction. For example, the seeding of a cloud with small hygroscopic particles leads to the growth of a certain portion of drops which had absorbed the particles or had formed on the particles as a result of decrease in pressure of the saturating water vapor above the solution. This portion of drops is altogether small in comparison with the remaining "pure" drops. The consumption of hygroscopic substances in such a method of influence is several kilograms per one cubic kilometer of clouds, containing from 100 to 1,000 tons of water. Investigation of these and other means of stimulating coagulation are being conducted now and some of them give encouraging results. It is reasonable to assume also that the reverse process, retardation of coagulation is possible in principle.

The effects of forced crystallization of a supercooled cloud, as well as stimulation of coagulation in a warm cloud, are used for three purposes: for the dispersal of clouds mainly of stratus and strato-cumulus form, for obtaining additional precipitation, and to change (retard or stimulate) the development of cumulus clouds.

The problem of the dispersal of supercooled clouds can be considered solved in principle. At present, in the USSR, a distinct technology designated for opening airports in winter is being completed and introduced into practice. Successful dispersal is being accomplished over expanses of 10 to 15 kilometers.

Dispersal of a cloud layer over a wide area, for example 10^4 to 10^5 square kilometers (which is now completely possible), and the change in the thermal balance of the layer as connected with it (equivalent evolution in it - about 10^7 calories per hour) can be studied as means of influencing larger scale atmospheric processes.

The obtaining of additional precipitation is the aim of a very large number of experiments conducted in foreign countries. Up to now, several thousands of such experiments have been conducted in the US, the Union of South Africa, Spain, Australia, and other countries, mainly by a method of systematic action on clouds from the surface with AgI smoke.

Appraisal of the effectiveness of the action is conducted by comparison of the quantity of precipation which fell from the "worked" territory, usually having an expanse of 50 to 100 kilometers, with that which fell on the closely located control area. A basic obstacle to correct appraisal is the large natural fluctuations characteristic for the compared magnitudes. Measurement of the quantity of precipitation which fell on a specified area presents no special difficulties; however, it is extremely difficult to estimate how much would have fallen in the absence of the influence. For this reason up to now, there is not a single opinion concerning the results of such experiments (cf., WMO. Technical note No 13. "Artificial Control of Clouds and Hydrometeors," 1955). It can be assumed however, than in the majority of cases, a positive effect on the order of about 10 percent in the mean annual quantity of precipitation is produced. Accumulation of data will definitely make it possible to answer accurately on this question in the near future.

It must be taken into account that even such a result could have practical value for agriculture in regions with insufficient moisture and also for increasing the water reserves in hydroelectric systems if it could be obtained with sufficient reliability over a territorial expanse of several hundred kilometers.

The least number of successes have been obtained in attempts to influence the rapidly developing form of cumulus clouds. The basic aim of interference in this case is to prevent violent development of such clouds and thus avoid formation of thunderstorms and hail.

Here, both crystallization of the supercooled portion and stimulation of coagulation in the warm lower portion of the clouds is implemented to produce precipitation and to disperse the cloud in the earliest possible stage of its development. Similar work is being conducted, for example, in the Alazani Valley (Georgian SSR) and also in Italy and France. Results obtained up to now are not great but give indications that the desired effect can be expected.

Thus, at present, means and methods have been obtained for the transformation of the structure of clouds and their dispersal over a considerable expanse. These methods fully satisfy the basic idea of active influence on elementary phenomena.

The presence of suitable links in the interconnected phenomena -- channels of control -- makes it possible to put large processes into motion with a comparatively insignificant amount of interference. It is sufficient to say that in influencing one cubic kilometer of a supercooled cloud (for which 200 grams of CO_2 are required), up to 1,000 tons of water transform from a liquid to a solid state and about 10^{11} calories of energy of crystallization are set free.

Although the composition of clouds has been transformed in certain cases, substantial results in controlling the process of their development still have not been obtained. To analyze the problem we shall examine a cloud and its interaction with the surrounding medium.

On the one hand, a cloud or a cloud system appears in that space where water vapor is present as the result of one or another circumstances and is transformed into water or ice. On the other hand, a cloud is an individual formation, a physical body which tears itself away from the currents supplying it and is transported by wind and develops according to laws peculiar to itself.

In the process of raining, a cloud does not lose its accumulated moisture in a simple manner but acts as a generator of moisture, transforming the moisture entering into it into a liquid or solid particles of sufficiently large size to fall out on the earth. It has been shown that a cloud system can give precipitation in a quantity which considerably exceeds its original moisture content. (Ye. F. Mamina, Ye. K. Fedorov, "Concerning the Water Balance in a Cloud System," Izvestiya Academii Nauk SSSR, Seriya Geofizicheskaya, No 5, 1957, p 658). The quantity of water vapor entering into a cloud which produces rain and that entering into a cloud which does not give rain obviously differs by more than an order of one. The questions which now appear are when and why does the influx of water vapor sharply increase during the formation of precipitates, and is this determined by external processes in relation to cloud processes or is the determining role played by internal effects which develop in the cloud itself in the process of supplying the cloud with water vapor?

Evidently, these and other processes operate in close interaction. In all probability, the role of internal factors and, above all, the release of the energy of condensation increases beginning with a certain specific stage in the development of the cloud. This role is particularly significant in the development of clouds of large vertical expanse, mainly hail and thunderstorm clouds.

At one time, the deficiency in the interaction of a cloud with its surrounding medium led a number of investigators to overestimate the results of the active influence used in experiments in the same way as the deficiency of internal factors in the development of a cloud favored certain pessimism in the appraisal of the possibilities of active influence.

Investigations of the interaction of a cloud with its surrounding medium, study of the balance and dynamics of moisture in the cloud, moisture resources of cloud systems (or synoptic processes forming them) should be considerably developed in the very near future. Only on this basis is it possible to make a correct appraisal and select means of active influence directed in particular toward obtaining significant precipitation.

In the problem of climate control, the question which arises is this: is it possible to obtain stable long-duration changes in the basic features of climate in any locality by artificial methods?

At present, the science of geophysics is still not in a position to give a clear and definite answer to this question. Information presented below is to show that the solution to this problem is possible and its investigation is of considerable scientific and practical importance.

As is known, the climate of one or another region is governed by its location on the Earth's sphere which, in turn, depends on the location of continents and oceans and on the amount of heat energy which reaches the surface of the Earth from the sun.

It is a known fact that climate changes. There is much indisputable evidence of large changes in climate in the geological history of the Earth. The shorter the period of time studied the less significant the variation of climate that will be noticed. However, in the course of the past millenium and century, the climate of many regions has changed appreciably.

Here it is not possible to examine many hypotheses explaining principles in change of climate, and we shall only remark that in recent times the greatest recognition concerns those which do not tie in the changes in climate with variations in the amount of radiated solar energy, essential changes in the position of the Earth's axis or large transformations in the surface of the Earth. It is true, however, that it would be difficult to explain the large changes of climate tied in with the termination of the last glacial period while reserving the mentioned principles.

As shown by various investigators, the qualitative analysis of basic characteristics of atmospheric circulation and its interaction with the underlying surface of continents and oceans, of the comparatively small changes in circulation, and of the small redistributions of thermal energy over the Earth appear to be quite sufficient for explaining the many noted changes in climate (K. Bruks [Brooks?], Klimaty proshlogo (Climates of the Past) Izdatel'stvo inostrannoy literatury, 1952).

Thus it is definitely not necessary to assume that Spitsbergen in some era of geological history was found in a tropical zone to explain the origin of the forests which gave the deposits of coal. A more direct and obviously a more appropriate actuality would be the assumption of a small increase in atmospheric circulation, as the result of which the heat transfer between the equator and the polar zones increased in such a way that at the expense of a small decrease in temperature in the tropic regions the temperature in the polar regions increased up to the point where the ice cover in the Arctic Ocean disappeared.

Here it is not possible to further develop this extremely interesting question but it will suffice to say that there are a number of serious conclusions indicating that the large variations of climate in the past were governed by changes in parameters of the atmosphere and in the character of atmospheric circulation which appeared as the result of geophysical factors and were not connected with large disturbances in the activity of the sun or in the structure of the Earth's surface.

Of considerable value in similar conceptions is the consideration of the close interaction between separate elements in the complex aggregate of hydrological and meteorological processes which sets conditions for climate and weather on the Earth.

An interesting example of the appearance of such interaction is the case of the El Nino ocean current passing by the shores of South America. A small change in the condition of this current in 1925, reasons for which are still not clear, involved very serious changes in the climate of Equador for several months.

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In speaking of local and transitory processes in the atmosphere, for example, the formation of precipitations in clouds, we discussed the critical conditions peculiar to them during which insignificant changes in certain parameters are capable of effecting large results. There is the possibility that such similarly critical conditions could exist in even larger processes, for example, in moisture circulation.

In studying the problem of regulating climate, we must take into consideration that man has shown in the far past, and is at present showing a specific although involuntary influence on certain features of climate. Through the influences of man changes are occurring in the underlying surface of the Earth which play a large role in meteorological processes. The wide expanses of territory over which changes in microclimate are occurring as connected with the above leads to the fact that climate itself in the broad sense of the word is experiencing certain, as yet unessential, but already noticeable changes. (Sf. M. I. Budyko and others, Izmeneniy klimata v svyazi s planom prebrazovaniya prirody zasushlivykh rayonov SSSR (Changing Climate in Connection With the Plan for Transformation of Arid Regions of the USSR) (Gidrometizdat 1952.)

Together with transformation of the underlying surface, man is also changing the chemical composition and electrical properties of the atmosphere on a much larger scale. Thus, for example, the ejection of CO_2 into the atmosphere by industry comprises a considerable portion in the geochemical balance of this substance. This portion is sharply growing. It is known that carbon dioxide strongly absorbs infrared radiation and its addition to the atmosphere noticeably changes the balance of radiant energy (Gilbert Plass.-In: Americal Journal of Physics, Vol 24, No 5, 1956, p 376)

The explosion of hydrogen bombs considerably changes certain electrical parameters for a long time in a significant portion of the entire Earth's atmosphere and possibly causes, whereas still small, a certain effect on moisture condensation processes. (Ye. K. Fedorov, "O vliyanii atomnykh vsryvov na meteorologichskiey prots esy" (Effect of Atomic Explosions on Meteorological Processes), Atomnaya Energiya, No 5, 1956, 103)

Consequently, man has become an involuntary climatogenic factor. While his influence on climate itself is small, it is growing at a very rapid tempo and it is possible that we are risking formation of considerable and possibly unsatisfactory and difficult to correct changes in climate sooner than we can learn to predict them.

The established changeability in large-scale meteorological and hydrological processes of long duration, their close interaction with one another, and their probable instability, and also the continually growing

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energy forces of man will enable him to find suitable channels of control in the complexes of climate formation which are accessible to our influence. As for the question of the point of application of such influence, an expedient transformation of the underlying surface can obviously be studied in this plan. It is very important to find out if there are critical moments in the processes of the moisture cycle and the role of its local ties.

One possible operation at present is the earlier mentioned dispersal of clouds over large territories. It is possible that it would be a suitable impetus for changes in the barometric condition.

Also of great interest is the interaction of phenomena which take place in the upper layers of the atmosphere under the action of solar and cosmic factors with the weather-forming processes in the troposphere. The mechanism is still not clear; however, it can be assumed that the energy transferred from the stratosphere into the troposphere is, in any case, small. This small quantity of matter found in the upper layers and its accessibility with modern technical means presents the possibility of an effective way to change the physical condition of these layers over a considerable expanse.

Of important significance in the problems studied is also the study of the history of climate and its changes.

In considering foreign concepts on weather control experiments, "of course, every scientific achievement could be used in one way or another for destructive purposes; however, the world-wide character of weather-forming processes must be taken into consideration. This property of theirs has required the close coordination and cooperation of the meteorological services of all countries in their daily operation and of such enterprises as the IGY. However, that which is necessary for analysis and understanding is required in an even greater degree for influencing or controlling weather on any large scale.

"The global (using a term that has caught the fancy of Americans) character of weather phenomena and the basic features of climate are least of all susceptible to any single interference in their composition.

"Any passive or pessimistic outlook on the insurmountability of elementary forces, we must counter with extensive investigations for possibilities and methods for controlling natural processes." (Voprosy Filosofii, No 4, 1958, pp. 137-144.)

Daily Variation of Magnetic Activity

The article, titled "On the Structure of the Daily Variation of Magnetic Activity," by V. M. Mishin, of the Magnetic-Ionosphere Station, Scientific Research Institute of Terrestrial Magnetism, Ionosphere, and the Propagation of Radio Waves, at Radio Station No 1, Irkutsk Oblast Radio Center, is based on data on the daily variation of magnetic activity collected for a period of 5 years by 34 northern and 7 southern observatories and considers the question of the structure of the daily variation and the nature of its chief components.

An equation, based on the Chapman-Ferraro theory, is given for the determination of the semiannual component of the seasonal variation. Such a determination, which was carried out in accordance with K-indices by the Zuy (Irkutsk) Observatory in the period 1930-1950, shows that this equation can be used to describe both the daily variation and the semiannual component of the seasonal variation. From investigations extending over several years' time it has been shown that the formula describes the semiannual component of the seasonal variation of activity in a minimum period with an 11-year cycle and a maximum period for which the Kort effect applies.

The nature of the component which is based on world time is determined in accordance with the influence of the rotation of the magnetic axis on the distribution of trails of primary corpuscular eruptions in the atmosphere. (Moscow, Doklady Akademii Nauk SSSR, Vol 118, No 6, 21 Feb 58, pp 1109-1112)

Scientific Center in the Pamirs Pursues Cosmic Ray Studies

Chechekta, the locale of a high mountain scientific center, lies in that area of Pamirs between Osha and Khorog. Here, at an altitude of 3,860 meters above sea level, the Pamirs Expedition of the Physics Institute of the Academy of Sciences USSR was based. In a short time the expedition transformed this especially chosen spot into a great scientific center where very interesting important work on the study of cosmic rays is conducted.

V. Bauderin, Izvestiya correspondent, who visited the center, states that the Soviet government aids in every possible way these scientists who are probing the secrets of the structure of matter. It is not surprising, he says, that a scientific city equipped with the latest research apparatus rose so quickly here. In the city are living quarters, laboratories, an electric power station, dial telephone system, work shops, a scientific library, etc.

Mainly, the city is provided with varied and very complex experimental material. Here are installed a 70-ton electromagnet, a cloud chamber, ionization hodoscope, and various devices for the automatic control of this complex system; in other words, all that is necessary to conduct experimental work on the modern level of science.

Much valuable work is done here by Moscow scientists and physicists. Academician D. V. Skobel'tsyn, Prof N. A. Dobrotin, and G. T. Zatsepin were awarded a Stalin Prize for a series of investigations. More than a hundred scientific works, many of which were on cosmic rays, have received wide publicity and recognition in the world of science. These were based on materials obtained in Chechekta.

These persistent investigations continue at present. Under the supervision of N. A. Dobrotin, Doctor of Physicomathematical Sciences, the investigation of nuclear interactions at energies of 50 billion electron volts continue. S. I. Nikol'skiy, Candidate of Physicomathematical Sciences and chief of the expedition, has begun the investigation of active nuclear particles with energies thousands of times greater than the above-mentioned energies.

The conduct of new experiments required much preparations. Now all of the instruments and apparatus with the aid of which the flow of cosmic particles over a wide area will be detected have again been set up.

The workers of Tashkent scientific research institutes conduct new original experiments here in cooperation with Moscow scientists. (Moscow, Izvestiya, 24 Jul 58)

IV. OCEANOGRAPHY

Expedition in Pacific Ocean

The Pacific Complex Geological-Geophysical Expedition of the Institute of Physics of the Earth, Academy of Sciences USSR, recently arrived in Petropavlovsk-Kamchatskiy. Detachments of scientific workers have gone out to work at sea.

The expedition was organized according to the IGY program. The area of its operations is very large, including the northwest part of the Pacific adjoining the Kurile Islands, Kamchatka, and the Komandorskiye Ostrova (Commander Islands), as well as all of the Sea of Okhotsk. Observations began in 1957 in the area of South Sakhalin and the Kurile chain of islands. The total length of aeromagnetic routes already covered is 21,000 kilometers.

Preliminary research materials obtained in the area surrounding Sakhalin show that the thickness of the earth's crust near South Sakhalin and in the southern part of the Kurile Islands reaches about 30 kilometers and below the ocean and the southern part of the Sea of Okhotsk -- 10-12 kilometers, including the water layer. It was discovered that below the Pacific Ocean one of the strata of the earth's crust is absent, i.e., granite.

A number of other scientific research organizations, in addition to the Institute of Physics of the Earth, are taking part in the expedition. The scientific research ship of the Academy of Sciences USSR, Akademik A. Bakh, is also operating in this area.

During 1958, the expedition will conduct research in the ocean along the coast of Kamchatka, in the central and northern parts of the Sea of Okhotsk, in the northern part of the Kurile Islands, and in other parts of the Pacific. The results of research, aside from being of purely scientific interest, are important for the purpose of studying the geological structure of these regions. (Moscow, Vodnyy Transport, 24 Jul 58)

Soviet Oceanographic Apparatus

Several new instruments successfully used by the Soviet Union in oceanographic work are mentioned in the report Soobshcheniye o Nauchnykh Rabotakh po Fizicheskoy Okeanografii (Report on Scientific Works in Physical Oceanography) Academy of Sciences, USSR, 1957, pp 21-23.

The instruments developed in the Institute of Oceanology, Academy of Sciences USSR are: the bottom scoop, "Okean-50" (for use at great depths in coarse and gravelly soils); a hydraulic deep-water soil corer (with which soil cores up to 34 meters long can be obtained); a hydraulic ejector for removing soil cores from the core tubes of the VRT-54 vibro-piston soil corer, which makes it possible to obtain soil cores of off-shore deposits without disturbing their stratification and internal structure); the PF-54, an apparatus for photographing the sea bottom at depths 3,500-4,000 meters; an anchored driftgraph; underwater television devices; "Okean" oceanographic winches; and deep-water trawling winches. (Referativnyy Zhurnal -- Geofizika, No 3, Mar 58, Abstract No 1850)

V. ARCTIC AND ANTARCTIC

Return of Greenland Sea Expedition

The high-latitude expedition of the Arctic Institute, conducting oceanological research aboard the Toros in the Greenland Sea, has returned to Leningrad. A. S. Denisov, chief of the expedition and scientific associate of the Arctic Institute, gave the following information to a correspondent of Tass.

The expedition studied problems of water and heat exchange with the Arctic Basin in the central and northern parts of the Greenland Sea. The discovery of seasonal changes and annual fluctuations in this exchange is important for the preparation of ice forecasts and for navigation on the Northern Sea Route.

The voyage of the Toros took place under favorable conditions. The ship crossed the 80th Parallel, and traveled a total of over 3,500 miles. Depth soundings were taken at various levels and the necessary water samples were obtained. The large amount of scientific material collected has now been delivered to Leningrad for processing in the laboratories of the Arctic Institute. (Moscow, Vodnyy Transport, 12 Jul 58)

Radio Report From Sovetskaya

The Soviet station Sovetskaya in the interior of Antarctica has registered the following average monthly temperatures: in March, minus 54.4 degrees centigrade; in April, minus 60.5 degrees centigrade; and in May, minus 67.2 degrees centigrade. The lowest temperature recorded during the antarctic winter has been minus 81.2 degrees centigrade. Such low temperatures have not been registered even at Oymyakon in the Yakutskaya ASSR, known until now as the cold pole of the earth.

Under these temperatures, metal loses its strength, rubber breaks, and diesel fuel becomes viscous and thick, like honey.

A great deal of effort and ingenuity is required on the part of the scientists for conducting scientific studies under these conditions. German Malikov, radio technician, and Genrikh Mayevskiy, aerologist, must be extremely careful and skillful in filling the rubber balloons of the radiosondes with hydrogen. Radiosondes are launched every day, in any kind of weather. No matter how cold it is, Vladimir Konstantinov, the station doctor, mans his post at the theodolite, watching the flight of the radiosondes. The data obtained by him make it possible to gain information on the temperature, wind speed, and direction at different altitudes above Central Antarctica.

Four times a day the station conducts meteorological and actinometric observations, to determine the heat balance of the high-mountain plateau of the continent. Observations of precipitation and surface drift of snow are also conducted. All these data are transmitted by radio to Mirnyy, to the weather forecasting institute in Moscow, and to several synoptic bureaus of the southern hemisphere.

Physical work in the cold and wind at an altitude of about 4,000 meters above sea level causes accelerated breathing. Precautions are taken to protect the lungs as much as possible from the icy air. In addition to special fur clothing, the men wear moleskin masks with respirators. The air entering the respirators from underneath the outer clothing has a slightly higher temperature than the outside air, and this prevents the lungs from freezing. Whenever one of the men goes outside the building, he is equipped in such a way that he looks like a diver. However, even with this kind of protection a man must not stay outdoors more than 30 or 40 minutes.

The living quarters are well heated. The small shacks connected by a common courtyard are equipped with water heat devices operating on coal. Diesel motors of the electric station are used for heating the bathhouse and for melting snow. The covered courtyard serves as a kind of club, where the scientists play chess, dominoes, watch movies, listen to radio broadcasts from Moscow, and read books from the 400-volume field library. The radio station maintains regular contact with Mirnyy, and frequently picks up signals from the third Soviet Sputnik. Radio amateurs of many countries frequently are in contact with Sovetskaya. -- V. Babarykin, chief of station Sovetskaya (Moscow, Ogonek, No 28, 6 Jul 58)

Scientific Observations in Antarctic

Meteorological, aerological, and other types of observations conducted at Soviet antarctic stations have revealed the fact that there is no permanent, steady type of weather on the ice cap of Antarctica, as it was formerly assumed. The weather in the center of Antarctica depends entirely on the nature of the air currents, i.e., the passage of cyclones and anticyclones. According to a preliminary analysis by Prof V. Bugayev, chief of the aerometeorological detachment of the expedition, it appears that the lowest temperatures occur at a time when, during a period of several days, only the intra-antarctic air circulates in the interior of Antarctica, without an exchange with the air masses of the outer parts of the continent or of the oceans surrounding Antarctica from all sides.

During the International Meteorological Interval, from 15 to 24 June, the interior and coastal stations had to double the number of radiosonde launchings and expand the range of other observations. For this purpose, a large number of specialists had to be assigned to various tasks. A proper distribution of forces made it possible to fulfill the work plan and the special observations required by the International Meteorological Interval.

The polar scientists have begun processing the materials obtained in the course of implementing the IGY program. For example, the data of seismic soundings of the ice cover, obtained during the sled-tractor traverse on the Mirnyy-Pionerskaya-Mirnyy route proved that beginning with the 250th kilometer south of Mirnyy, there is a continuous continent below the 2-kilometer ice cap, with elevations of 600-700 meters above sea level.

Expedition pilots make regular ice reconnaissance flights over Davis Sea and the Indian Ocean. Ice reconnaissance has shown that the ice edge has retreated about 500 kilometers from the shores of Antarctica. In the area of Mirnyy, recordings of tides are made, which are of a very complex nature. The water together with the ice sometimes rises to about 2 meters, forming a tidal crack along the entire ice barrier. The frost does not prevent the biologists from conducting observations of marine life and of the colony of Emperor penguins living among the icebergs near Haswell Island.

Since the first days after the launching of the third Soviet earth satellite, radiomen at Mirnyy have been conducting observations of it.

Beginning with 22 June, the antarctic night began to diminish. On this occasion the traditional exchange of friendly radiograms took place among antarctic stations of the US, Great Britain, France, Australia, Norway, and other countries.

Preparations are being made for a new sled-tractor train which will travel into the interior at the beginning of the antarctic spring. Soviet scientists will conduct an extensive cycle of studies in the central part of Antarctica. (Moscow, Vodnyy Transport, 24 Jul 58)

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